



TRAMPOLINES AT HOME AND PLAYGROUNDS

A joint statement with *Canadian Paediatric Society*
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INTRODUCTION

Trampolining was introduced in 1936 by George Nissen, a circus acrobat (1-7). Since the 1950s, the recreational use of trampolines has increased dramatically, particularly in North America, Europe and Australia (1). In the US, backyard trampoline sales exceed 500,000 units annually (1).

Injuries resulting from the use of trampolines have been well documented in the medical literature for the last 50 years (1, 2, 4-16). Trampoline injuries are increasing over time (1, 15, 17-19). One study showed a 98% increase in trampoline injuries between 1990-1995 (1). Many of these injuries require hospitalization with or without surgery resulting in permanent morbidity (1, 2, 4-19). The vast majority of injuries are in the pediatric age group (18-22).

This paper reviews injuries sustained by children as a result of the recreational use of home trampolines, including the incidence, types, and circumstances of injuries, as well as the disposition of children following injury. A literature review on trampoline injuries was done using Medline from 1966 until April 2006. Canadian injury data was provided by the Public Health Agency of Canada. Recommendations regarding the recreational use of home trampolines by children are included. Injuries resulting from the use of trampolines in school physical education programs, as part of training or competition for sport, such as diving, gymnastics or trampolining, or the use of trampolines under the direct supervision of a therapist for the rehabilitation of an injury are not discussed.

TRAMPOLINE INJURIES

The prevalence of trampoline injuries in the pediatric age group appears to be rising. The main source of data on trampoline injuries in Canada is the Canadian Hospital Injury Reporting and Prevention Program (CHIRPP), a computerized information database that records injuries in patients from fourteen emergency departments, including 10 children's hospitals. The Public Health Agency of Canada has published numerous CHIRPP studies related to trampoline injuries. Between 1990-1998, there was almost a four-fold increase in the number of injuries sustained by children from trampolines, from 149 in 1990 to 557 in 1998 (18). There was also a significant increase in the number of



injuries between 1999 and 2003, particularly between 2002 and 2003 (Table 1) (19). This is likely an underestimate of trampoline injuries as this database does not capture children with injuries presenting to a doctor's office or walk-in clinic, or to a hospital not included in the CHIRPP network. Fatal injuries are also under-represented as the CHIRPP database does not capture information on deaths occurring prior to reaching hospital or after hospitalization (18). The CHIRPP data also does not reflect exposure rates/participation rates. Therefore, the increase in injury rates may be explained by an increase in trampoline utilization.

The severity of trampoline injuries is also concerning. Using hospital admission rates as a measure of injury severity, trampoline injuries result in greater harm than injuries incurred in other sports/recreational activities. In Canada, despite the fact that trampoline injuries occur less often than other sport and recreation-related injuries, perhaps reflecting lower participation rates, they result in a relatively greater frequency of hospital admissions (Table 2) (personal communication). CHIRPP data also confirms that between 1990 and 2001, there was a 56% increase in the number of hospital admissions resulting from trampoline-related injuries (19).

Injury Type, Circumstances, and Patient Disposition

Summary CHIRPP data for 1998 revealed that the majority of trampoline-related injuries occurred in the 5-14 year age group (78.9%) and most (72.2%) occurred during home recreational use. Fractures were the most common injury (48.6%), most often (57.7%) in the upper limb, and accounted for the majority of hospital admissions (86.3%). The overall hospital admission rate was 13.1%, compared with an overall admission rate of 6.8% for the entire CHIRPP database during the same time period. Of admitted patients, 82.2% were in the 5-14 year age group.

The most recent CHIRPP statistics reported on trampoline injuries from 1999 to 2003 (Table 1) (19). This study included backyard trampolines only; mini-, exercise and water trampolines, as well as incidents occurring at gymnastics clubs and schools, were excluded. Youth between 10-14 years of age accounted for 43.3% of these injuries, with a median age of 10.1 years. Fractures were most common (47.2%), with 62.5% in the upper extremity. The hospital admission rate was 12.4%, more than double the admission rate (5.9%) for all injuries in the CHIRPP database for the same time period. Half (52.4%) of patients were injured on the mat of the trampoline, while 14.3% were injured when multiple people were on the trampoline mat (19).

A regional Canadian study found similar results (6). Black and Amadeo reviewed orthopedic injuries in children resulting from the recreational use of a trampoline in Winnipeg. The majority of these injuries occurred in children between 5 and 9 years of age (49%). Sixty five per cent of the children were injured on the trampoline mat, while 30% were injured when they fell off the trampoline. Thirty five per cent of children were injured when there were multiple children on the mat. The most common injury was a fracture or fracture/dislocation (75%); with the upper extremity most often involved (forearm 45%, humerus and elbow 35%). There was one fracture-dislocation of the cervical spine with paralysis in an 8 year old boy who fell off the trampoline mat. There were no reported deaths. Ten per cent of cases occurred under adult supervision (6).

The World Perspective

A number of studies from other countries have also looked at trampoline injuries in children (1, 2, 4, 6, 7, 13-19, 21, 22). A review of these papers, including the previously stated Canadian data, is summarized as follows:

Ages most at risk: The majority of trampoline injuries occurred in the 5-14 year age group, with the average age between 7 and 10 years (1,6,7,13-15,17-19,22). This age group also had the most trampoline-related hospital admissions (4, 18).

Most common injuries: The majority of studies found fractures were the most common injury (32-75%) (1,4,6,13,15,17-19,21,22) and the most frequent reason for hospital admission (1,17,18,21,22). Two small retrospective studies found that sprains and strains were the most common trampoline-related injuries (2, 14).

Most common site of injury: The extremities, especially the upper limb, were injured in 30-80% of cases (1, 4, 6, 7, 13, 17-19, 21, 22). Two small retrospective studies found that the lower limb was involved more often (2, 14).

Circumstances: Most trampoline injuries (71-99%) occurred at home or at a neighbor's house (1, 2, 4, 7, 15, 17, 18, 21, 22). Up to 83% of injuries happened when there was more than one child on the trampoline at the same time (6, 7, 13, 15, 17, 19). The majority occurred as a result of falling on the trampoline mat (52-66%) (6,7,13,15,17,19). With the exception of one study, which found that 80% of injuries occurred as a result of falling off the trampoline (4), falls off the trampoline accounted for 30% or less of injuries



(6,7,13,15). Less common circumstances resulting in injury included attempting stunts, such as somersaults or flips (7, 15, 20), and imaginative play, such as jumping off a ladder onto the trampoline mat (15). Seasonal injury peaks occurred in the spring and summer months, when backyard trampolines are mostly in use (1, 6, 7, 13, 15, 18, 19, 21, 22).

Disposition of children: Most children were discharged home following evaluation of their injuries in the emergency department (18, 22). Hospital admission rates ranged from 3% to 17% (1, 2, 7, 13-15, 17-19, 21). One New Zealand study showed an increase in hospital admission rates for trampoline injuries from 3.1 to 9.3 per 100,000 per year from 1979 to 1988, with the highest admission rate in the 5-9 year age group (30.3 per 100,000 persons per year) (4). The majority of admissions resulted from fractures (1, 6, 17, 18, 21, 22), with 6-17% of children requiring surgery (7, 13, 15, 17).

Serious Injury: There have been reports of rare but serious injuries resulting in significant morbidity associated with trampolines, including cervical spine injuries (5, 6,8-10,15,16,19), vertebral artery dissection (23), significant knee ligamentous injuries (9,24), popliteal artery thrombosis (25), and ulnar nerve injury (26). Cervical spine injuries are perhaps the most concerning because of the potential for significant long term morbidity. One study in children found 12% of injuries were spinal injuries, including 7 cervical or thoracic fractures and one with C7 paraplegia (15). Torg reviewed 114 catastrophic cervical spine injuries resulting in quadriplegia associated with trampolining (5, 11, 12). The majority of these injuries occurred in highly trained athletes during training sessions, indicating that training with experienced supervision does not prevent these catastrophic injuries (5, 9-12).

EXISTING POLICY

Trampolining is a high-risk activity with the potential for significant injury, especially in children and youth. Multiple authors, including the American Academy of Pediatrics (AAP) and Safe Kids Canada, have called for the elimination of trampolines in the home environment as recreational play equipment (1-4,7,8,14,17,27) or for an outright ban on trampolines under any circumstances for the pediatric age group (5,9-12,15,16) (Table 3). Others, including Health Canada and the American Academy of Orthopedic Surgeons (AAOS), have advocated for specific pediatric limitations, including no participation by children less than 6 years of age, only one child on the trampoline mat at a time, parental supervision, and no flips or tricks (6,7,13,21,22,25,28,30,31).



Regarding the limited use of trampolines in supervised competitive training programs, such as trampolining, diving, and gymnastics, the AAP (17) and the Victorian Injury Surveillance System (VISS) (21,22) have recommended that the following safety measures be strictly adhered to: the use of safety pads covering the frame and springs of the trampoline, as well as the surface surrounding the trampoline; the presence of competent spotters trained in trampoline safety at all times when the trampoline is in use; only one person on the trampoline at a time at the center of the mat; avoidance of maneuvers beyond the athlete's skill level; and the use of safety harnesses when learning or practicing more advanced skills.

Despite these safety recommendations, significant trampoline-related injuries in children continue to occur. For instance, in Australia, despite the existence of clear recommendations for the safe use of trampolines since 1992 (21), there were 1,355 trampoline-related injuries in children less than 15 years of age presenting to emergency departments in Victoria over the period 1995 to 1999, 16% of whom required hospital admission (22).

CONCLUSIONS

Trampoline injuries occur frequently in the pediatric age group. The majority of injuries and hospital admissions occur in the 5-14 year age group. There has been an alarming increase in the rate of hospital admissions in Canada resulting from trampoline-related injuries, mostly for fractures of the upper extremities. The majority of trampoline injuries occur on backyard trampolines as a result of falls on the mat of the trampoline, negating the notion that spotters around the outside of the trampoline, parental supervision or even safety enclosures can eliminate injuries. Many injuries occur when there are multiple users on the trampoline at the same time and when there is inadequate supervision.

Numerous authors and organizations, such as the AAP, have made recommendations against the use of trampolines by children. Other organizations, such as the AAOS, Health Canada and the Consumer Product Safety Commission (CPSC), have recommended specific restrictions on the use of trampolines in the pediatric age group. Despite these warnings, however, trampoline injury rates continue to rise.



RECOMMENDATIONS

The use of trampolines is a high-risk activity with the potential for serious injury. The rapid increase in injuries related to the recreational use of trampolines by children is evidence that current preventive strategies are ineffective to prevent the majority of injuries. Therefore, the Canadian Academy of Sport Medicine and the Canadian Paediatric Society recommend that:

- Trampolines should not be used for recreational purposes at home (including cottages and temporary summer residences) by children or adolescents.
- Health care professionals, including family physicians and pediatricians, should warn parents of the dangers of trampolines as a recreational toy at routine health care visits. Parents should be advised to avoid the purchase of trampolines for the home, as enclosures and adequate supervision are no guarantee against injury.
- Trampolines should not be regarded as play equipment and should not be part of outdoor playgrounds.
- Physicians should advocate for legislation to require warnings of trampoline dangers to be put on product labels.
- More research on trampoline injuries sustained in supervised settings, such as schools, gym clubs, and training programs, should be conducted to assess the risk of injury in these settings.

TABLE 1: Backyard trampoline injuries, all ages, CHIRPP database 1999-2003 (19).
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YEAR	# CASES	CASES/100,000 CHIRPP
1999	459	450.4
2000	469	441.5
2001	503	473.4
2002	594	549.3
2003	680	639.7
Total	2,705	511.5

Table 2. Frequency of sports and recreation (SPAR) injuries, CHIRPP database, 1999-2003, ages 1 year and older, both sexes. Reproduced with permission.*



ACTIVITY	ESTIMATED # OF INJURIES ¹	% OF ALL SPAR	INJURIES ADMITTED TO HOSPITAL (%)
Bicycling	15,945	10.2	10.2
Soccer	14,822	9.5	2.5
Ice Hockey	13,759	8.8	3.3
Football	7,217	4.6	2.8
Snowboard	6,314	4.0	12.0
Ice skating	3,802	2.4	3.2
Sledding	3,796	2.4	9.4
Alpine skiing	3,497	2.2	12.9
Trampoline	2,705	1.7	12.4
Overall SPAR	156,717	100.0	5.3

¹ Based on a search of contributing factor codes; frequencies are estimates based on uncleaned data.

*Personal communication from Steven McFaull, Senior Research Analyst, Injury and Child Maltreatment Section, Health Surveillance and Epidemiology Division, Public Health Agency of Canada.

TABLE 3: Policy regarding trampoline use by children

ORGANIZATION	POSITION
Health Canada (PHAC) (2005) (28)	Advises caution with restrictions: adequate supervision; one person at a time; older than 6 years; no ladders; no somersaults; shock-absorbing pads; enclosure netting; trampoline at ground level
American Academy of Pediatrics (AAP) (1999) (17)	Trampolines should not be used at home; parents should never purchase /allow children to use home trampolines. Trampolines should not be in playgrounds, viewed as play equipment or be part of



	physical education classes. Limited use of trampolines in supervised training programs with use of safety pads, safety harnesses/spotting belts, trampoline mat at ground level, only one person at a time, competent spotters.
Safe Kids Canada (2005) (27)	Adheres to AAP recommendations.
American Academy of Orthopedic Surgeons (AAOS) (2005) (25)	Trampolines should not be used for unsupervised recreational activity and never by children less than 6 years. Adherence to CPSC guidelines.
Consumer Product Safety Commission (CPSC) (2000) (30)	Only one person at a time; no somersaults; shock-absorbing pads covering springs, hooks, frame; placing trampoline away from structures/play areas; no ladders; older than 6 years; supervision at all times; enclosures.
Department of Consumer and Employment Protection, Government of Western Australia/KIDSAFE WA (2001) (31)	Children under 6 should be supervised at all times; older children should have strict guidelines for use; one person at a time; bounce near centre of mat; step on and off mat; avoid risky maneuvers.
Victorian Injury Surveillance System (VISS) (1992; 2000) (21, 22)	Trampolines should not be regarded as play equipment; parents not encouraged to purchase backyard trampolines. Ideally trampolining should be done in a supervised setting with trained personnel, using harnesses for difficult manoeuvres. If parents purchase backyard trampolines, they should only be used with strict adult supervision; no somersaults; one person at a time; keep to center of mat; step on and off mat.



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